



NHTSA's 2005 ESC Research Program: An Overview

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Presentation Overview

- **Program Objectives**
- **Background**
- **ESC Effectiveness Research**
- **Government and Industry Cooperation**
- **Conclusions**
- **Sources for Additional Information**

Program Objectives

- **Validate and refine NHTSA's proposed ESC identification criteria**
- **Work with industry to collaboratively gather data**

- **2004 Research Objectives:**
 - Perform research supporting the development of maneuvers capable of objectively assessing handling
- **Results from the handling tests would supplement NCAP rollover ratings**
- **Five diverse test vehicles used**
 - Evaluated with ESC enabled / disabled

Background (continued)

- Midway through 2004, NHTSA expressed an increased interest in ESC effectiveness
- Focus of maneuver development changed from handling to ESC effectiveness
- By late 2004, NHTSA had isolated a reduced suite of test maneuvers and proposed ESC effectiveness criteria

ESC Research

Effectiveness Criteria

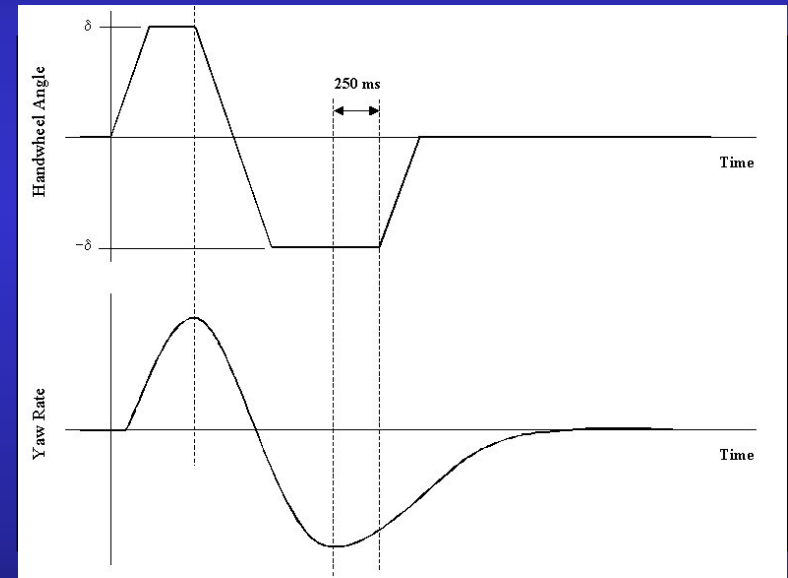
- **A vehicle with an effective ESC should:**
 - **Not spinout***
(lateral stability measure)
 - **Be able to achieve a minimum lateral displacement***
(responsiveness measure)
 - **Not produce two-wheel lift**
 - **Not produce rim-to-pavement contact or tire debanding**
- **These criteria must be satisfied during one of four specialized maneuvers presently being evaluated**

** discussed in this presentation*

Test Maneuvers

Performed With A Steering Machine

- **Slowly Increasing Steer**
(for characterization use only)
- **0.7 Hz Sine with Dwell**
- **0.7 Hz Increasing Amplitude Sine**
- **500 deg/s Yaw Acceleration Steering Reversal**
- **500 deg/s Yaw Acceleration Steering Reversal w/Pause**



Test Conditions

- **ESC enabled and disabled**
- **Test surface**
 - Dry, high-mu asphalt
 - Maneuvers initiated while vehicle is being driven up a 1% grade
- **Nominal load**
 - Driver
 - Instrumentation
 - Outriggers if vehicle is an SUV, pickup, van, minivan, station wagon, or crossover vehicle

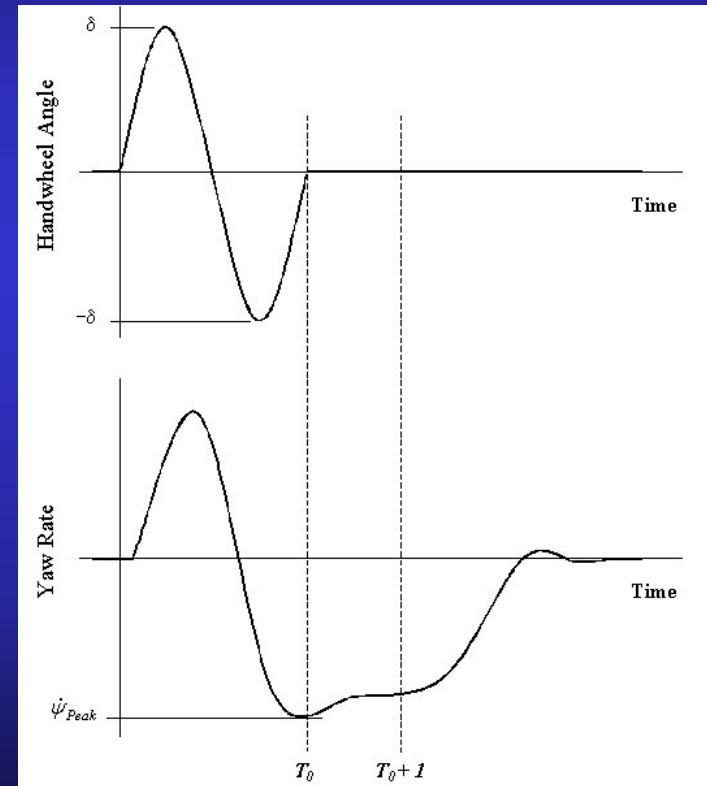
What is a “Spinout”

Preliminary Definition

$$\text{Percent } \dot{\psi}_{Peak} = 100 * \left(\frac{\dot{\psi}(t)}{\dot{\psi}_{Peak}} \right)$$

Set $t = t_0 + 1$

Spinout occurs if $\text{Percent } \dot{\psi}_{Peak} \geq 60\%$



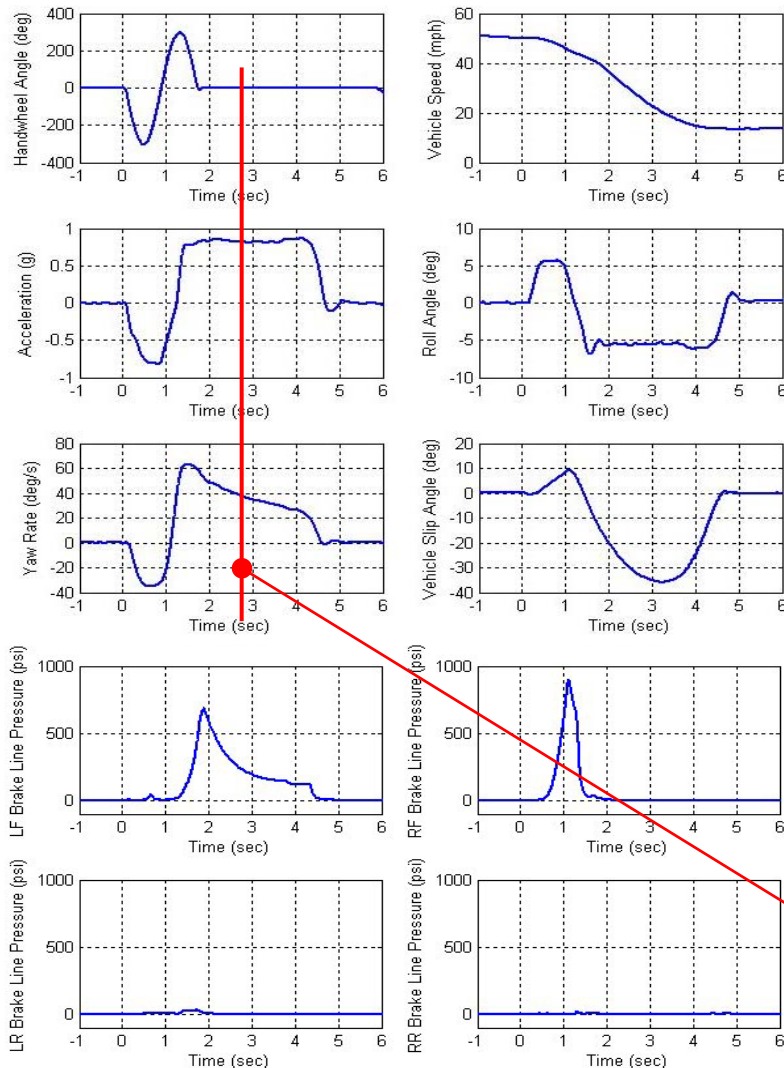
What is a “Spinout” Threshold Example

0.6 Hz Sine Steer, SWA = 300 degrees



At $t_0 + 1$, Percent $\dot{\psi}_{Peak} = 60.6$

$$t = t_0 + 1$$



What is a “Spinout”

Sample Video

0.7 Hz Sine with Dwell

2004 Volvo XC 90
ESC Disabled
SWA = 120 degrees

At $t_0 + 1$, Percent $\dot{\psi}_{Peak} = 18.9$

Threshold not exceeded

2004 Volvo XC 90
ESC Disabled
SWA = 130 degrees

At $t_0 + 1$, Percent $\dot{\psi}_{Peak} = 84.1$

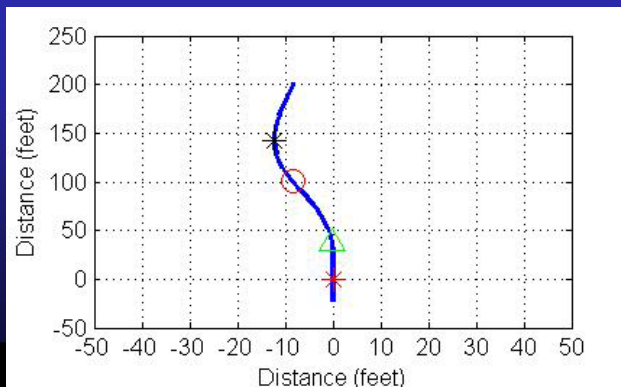
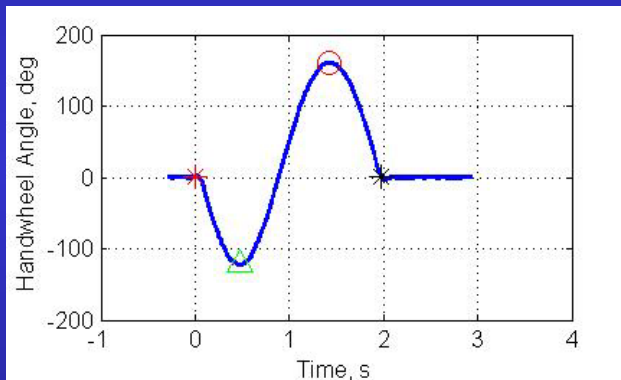
Threshold exceeded

Lateral Displacement

- **An effective ESC should not impede responsiveness**
 - Proposed minimum lateral displacement: 12-ft
 - Must be achieved prior to completion of a maneuver performed with δ_{\max}
- **Measured via GPS during testing**
 - Referenced to pre-maneuver heading
- **NHTSA's evaluation criterion will not penalize vehicles equipped with rollover mitigation technology**

Lateral Displacement Threshold Example

*0.6 Hz Increasing Amplitude Sine,
Lateral Displacement = 12.2 ft*

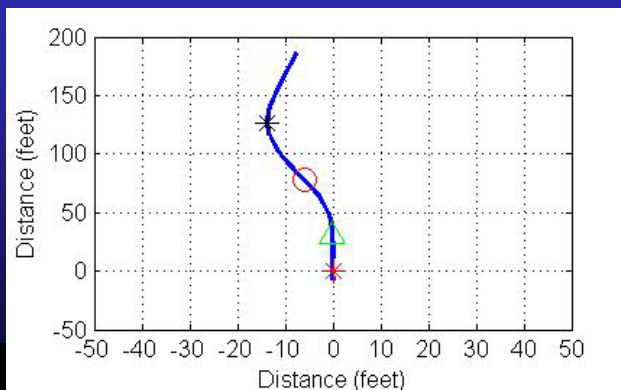
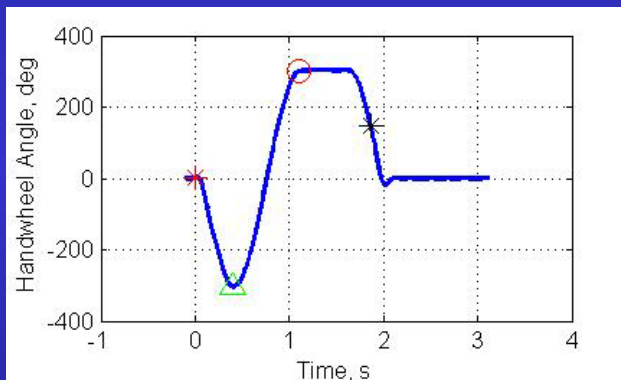


**2004 GMC Savana
ESC Enabled
SWA = 160 degrees**

Lateral Displacement

Effects of an RSC

*0.7 Hz Sine with Dwell,
Lateral Displacement = 13.7 ft*



2004 Volvo XC 90
ESC Enabled
SWA = 300 degrees

Government and Industry Cooperation

- **NHTSA hopes to collect data from 50 vehicles in 2005**
 - Will help select the most efficient maneuver capable of determining whether a vehicle is equipped with an ESC
 - Used to improve the robustness of the spinout model
 - Will help assess the lateral displacement capability of ESC-equipped vehicles
- **A cooperative testing effort between NHTSA and industry is underway**
 - Test data from industry-evaluated vehicles is critical

Conclusion

- ESC research is a top priority for NHTSA
- Preliminary ESC effectiveness criteria have been identified
- A cooperative testing effort between NHTSA and industry is underway

Additional Information

- **ESC Docket**

- <http://dms.dot.gov/search/searchFormSimple.cfm>
- Number 19951

- **VRTC ESC Website**

- <http://www-nrd.nhtsa.dot.gov/vrtc/ca/esc.htm>